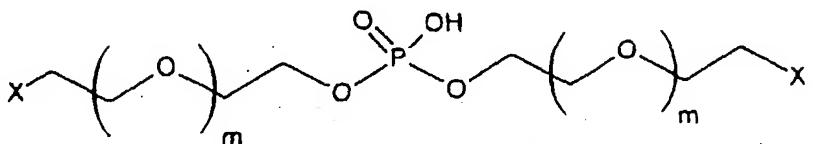
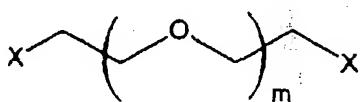
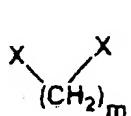


CLAIMS

1. Method for the attachment and/or self-organization of biological macromolecules, characterized in that it essentially comprises the incubation, without stirring, for at least 15 minutes, of a biological macromolecule in solution with nanotubes of carbon closed at their ends, under suitable temperature and pH conditions.
- 10 2. Method according to Claim 1, characterized in that the said biological macromolecules are in particular soluble, membrane or transmembrane proteins, enzymes, antibodies, antibody fragments or nucleic acids.
- 15 3. Method according to Claim 1 or Claim 2, characterized in that the said nanotubes of carbon are functionalized by physical adsorption, at their surface, of a chemical reagent of general formula H-E-L,
20 in which:
 - H represents a hydrophilic group selected from the positively or negatively charged groups; ligands or analogues of biological macromolecules; organometallic complexes interacting with amino acids or nucleic acids and whose ligands are optionally functionalized with alkyl groups for bonding to E;
 - E represents a spacer arm, selected from C₁-C₁₀ carbon chains, optionally substituted with alkyl groups, having unsaturations or otherwise or
25 polyoxyethylene units which may have or otherwise in the middle of the chain phosphate groups, such as:

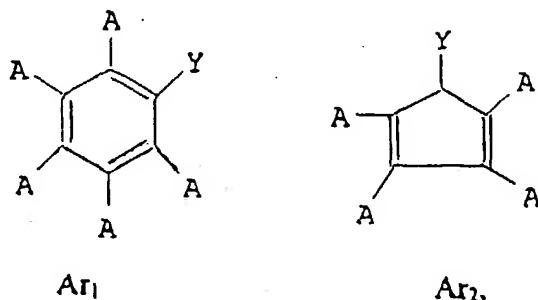


in which:

m represents an integer from 1 to 10,

X represents O, NHCO, OCO, COO, CONH, S, CH₂ or
5 NH and constitutes, at the ends of the said carbon chains, organic functions for adhesion of the ester, amide, ether or thioether type;

- L represents a lipid unit with one or more chains of variable length, in the form of C₁₂-C₂₀ having 10 unsaturations or otherwise; an aromatic group of formula Ar₁ or of formula Ar₂:



15 in which:

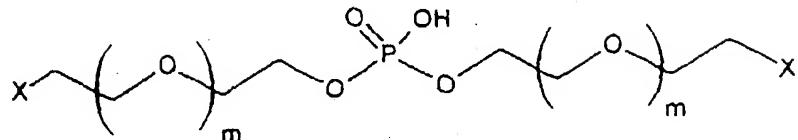
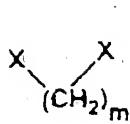
A represents a hydrogen atom, one of the following groups: alkyl, CF₃, NO₂, NH₂, OH, O-alkyl, S-alkyl, COOH, halogen, an aromatic ring or an aromatic heterocycle in the form of C₄-C₆, optionally 20 polysubstituted with electron-donating groups of the alkyl type or electron-attracting groups of the CF₃ or halide type; and

Y represents a bond with E.

4. Method according to any one of Claims 1 to 3, 25 characterized in that the said solution consists of a solvent for solubilizing the said biological macromolecules, which is aqueous or aqueous-alcoholic and which optionally contains at least one detergent.

5. Method according to any one of Claims 1 to 4, 30 characterized in that the incubation conditions are preferably the following: incubation at room temperature, for 15 minutes to 48 hours, at a pH of between 5.5 and 8.5.

6. Bionanomaterials, characterized essentially in that they consist of nanotubes of carbon, on which biological macromolecules are attached by means of non-covalent bonds.
- 5 7. Bionanomaterials, characterized essentially in that they consist of nanotubes of carbon, on which biological macromolecules are self-organized in a crystalline form.
8. Bionanomaterials according to Claim 6 or 7, 10 characterized in that they are obtained with the aid of a method according to any one of Claims 1 to 5.
9. Use of the bionanomaterials according to any one of Claims 6 to 8, for the structural study of the biological macromolecules which are associated with 15 them.
10. Use of the bionanomaterials according to any one of Claims 6 to 8, as biological reagent.
11. Use of the bionanomaterials according to any one of Claims 6 to 8, as biosensors or bioconductors.
- 20 12. Chemical reagent capable of being physically adsorbed on nanotubes of carbon, characterized in that it has the general formula **H-E-L**, in which:
- **H** represents a hydrophilic group selected from the positively or negatively charged groups; 25 ligands or analogues of biological macromolecules; organometallic complexes interacting with amino acids or nucleic acids and whose ligands are optionally functionalized with alkyl groups for bonding to **E**;
- **E** represents a spacer arm, selected from C₁-C₁₀ carbon chains, optionally substituted with alkyl groups, having unsaturations or otherwise or polyoxyethylene units which may have or otherwise in 30 the middle of the chain phosphate groups, such as:

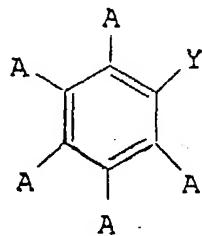


in which:

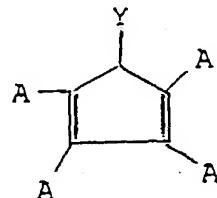
m represents an integer from 1 to 10,

5 X represents O, NHCO, OCO, COO, CONH, S, CH₂ or
NH and constitutes, at the ends of the said carbon
chains, organic functions for adhesion of the ester,
amide, ether or thioether type;

10 - L represents an aromatic group of formula Ar₁
or of formula Ar₂:



Ar₁



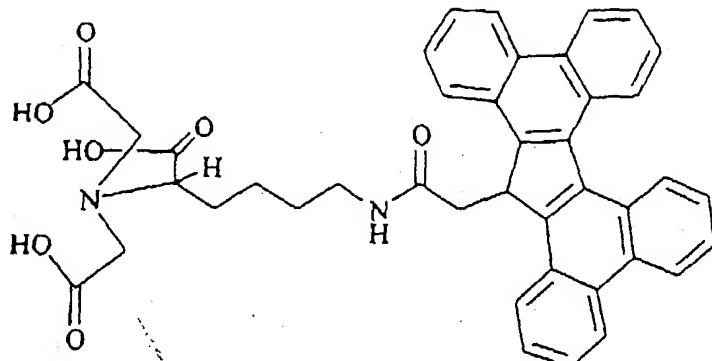
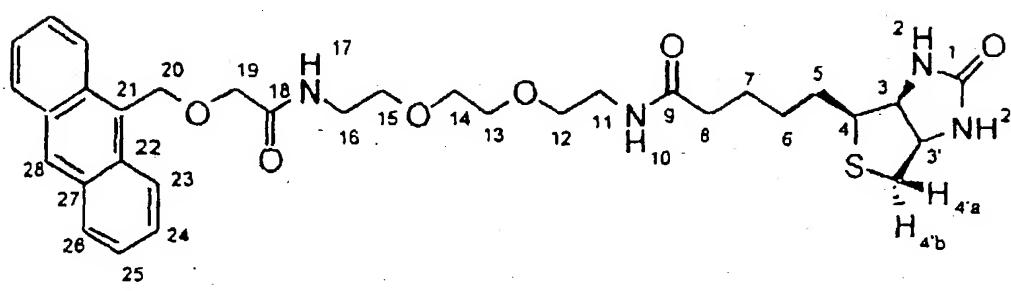
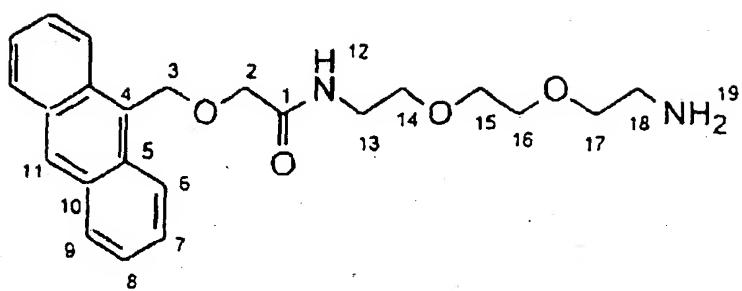
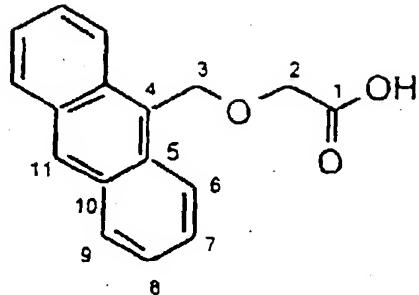
Ar₂,

in which:

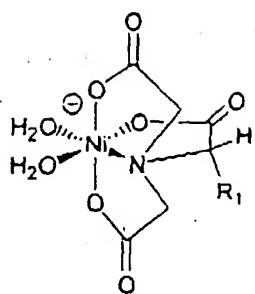
15 A represents a hydrogen atom, one of the
following groups: alkyl, CF₃, NO₂, NH₂, OH, O-alkyl, S-
alkyl, COOH, halogen, an aromatic ring or an aromatic
heterocycle in the form of C₄-C₆, the said rings being
20 optionally polysubstituted with electron-donating
groups of the alkyl type or electron-attracting groups
of the CF₃ or halide type; and

Y represents a bond with E.

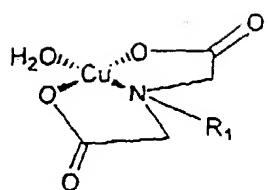
13. Chemical reagent according to Claim 12,
characterized in that it has one of the following
25 structures:



14. Chemical reagent according to Claim 12,
5 characterized in that H is selected from the following
organometallic complexes:



Ni-NTA complex



Cu-IDA complex

5

with R_1 = organic group for bonding to E.

THE FOLLOWING IS THE ENGLISH TRANSLATION OF THE
ANNEXES TO THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT : AMENDED SHEETS (Pages 20, 21, 22, 23,
24 and 25).